Numerical and experimental elbow flow evaluation of dense fluids at high Reynolds number

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Abstract

The turbulent flow of dense fluids through piping singularities such as section changes or bends may be the source of steady-state low-frequency vibrations, which can lead to fatigue failure. The appropriate modeling of the unsteady flow through a singularity is an important step in the evaluation of flow-structure interaction phenomenon. In this study, numerical simulations of water flowing through a 90° circular bend at Reynolds number 5.6×10^5 were compared to experimental data in order to validate the computational approach. Particle Image Velocimetry (PIV) techniques were employed to experimentally characterize the water flow at multiple planes upstream, downstream and over a transparent bend. Large-Eddy Simulations (LES) of the water flow for the same Reynolds number and elbow geometry were conducted and made it possible to compare the

numerical and experimental velocity profiles in the bend exit and downstream of it. The average and fluctuating velocity fields obtained by the simulations are validated and a discussion of the main flow coherent structures formed in the bend is proposed.